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the Leaver begins to move. This will be evident, if you let the Weight 4. hang at D, whilst the Weight 1. lies above it : For if then you move the Leaver, the Weight 1. will rise four times as fast as the Weight 4.

XI. *A Method for rowing Men of War in a Calm. Communicated by Monsieur Du. Quet.*

TO perfect the Art of Navigation, Two Things seem principally wanting ; viz. An easy Method for finding the Longitude at Sea ; and a Way to give a Vessel its Course, when there's no Wind stirring.

I flatter my self to have found the last ; and hope to make it appear, by Reason and Experiment, That a Man of War may make a League an Hour in a Calm, by Means of revolving Oars, which are easily apply'd to the Sides of the Ship, without occasioning any Incumbrance : As I shall make appear by the following Account, after having deliver'd my Notion of the Motion of Bodies in Fluids.

A Body swims upon Water, when it weighs less than the Volume of Water, whose Place it takes up ; and it sinks more or less in the Water, only in proportion as its Volume is more or less increas'd.

A Body lying in still Water, is as it were in *Æquilibrium* ; the least Effort gives it Motion, and makes it lose that *Æquilibrium*. If the Effort be continued, tho' ever so little, the Motion it communicates will be ve-

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ry sensible. How great soever the Weight of the Body be, when once it is in Motion, it will always continue so, if nothing hinders.

Upon these Principles, I consider the Motion a Vessel receives by means of Oars, and the Application of Hands that set it a-going. The *Impetus* of the Hand, apply'd at one End of the Oar, and the Resistance the Water makes against the other End, are both impress'd upon the Point, where the Oar rests upon the Vessel. This Point is like the *Fulcrum* of the common Leaver, which always bears the Sum of the Weights at both Ends, besides the Weight of the Leaver it self: So that the greater the Effort is at one of the Oars, and the Resistance at the other, so much the greater is the Impression, which the Point or *Fulcrum* receives, in order to its being put in Motion. A Galley, with two Oars only, would go as fast as it does with the usual Number; provided the same Number of Hands were apply'd with equal Vigour to the two Oars, and the Oars were strong and broad enough to make the necessary Resistance: Because then the *Fulcrum* of the two Oars would receive as much Impression, as all the *Fulcra* of the common Oars taken together.

This Consideration put me at first upon contriving a Way, how to apply a greater Number of Hands to the common inclined Oars; but, after several Tryals, I threw them aside, and made use of perpendicular Oars; because the first do only skim the Water, and (when the Sea is rough, and the Waves run high) they don't take Water oftentimes, and so become useless. For, in this Case, the Rowers are tript up, for want of meeting a Resistance.

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This Inconvenience is avoided by the revolving Oars ; because they take the Water perpendicularly, and enter far enough not to miss it : And if the Water should happen to evade the Stroke, the Rowers would not be so incommoded ; because they would be supported at every Vibration, which is only of three Foot. Besides, in the Use of inclined Oars, more than half the Time is lost, in raising and recovering the Oar, before they give the Stroke ; which makes the Vessel move by fits and jerks, so that the People aboard feel (as it were) every Stroke of the Oars when they play ; whereas, the revolving Oars always move equally, and succeed one another without Loss of Time ; which makes the Vessel move uniformly, without affecting those who are aboard.

It is to be observ'd too, that a Gally built on purpose for the Use of inclined Oars, would not be so proper as another Vessel for perpendicular Oars ; because the Gally has a considerable Length and but little Height above the Water.

Having propos'd this Invention to the Court of *France*, I was sent to *Havre de Grace*, to make a Tryal, which had the Approbation of the Intendant. He made his Report, That the Officers at first object-ed to the Invention ; but as for his own part, the more particularly he consider'd it, the more he was convinc'd of its Usefulness. I was afterwards sent to *Marseilles*, where I made several Tryals on board a Gally ; the Swiftnefs of which was compar'd with that of another Gally, equipp'd as usual. *M. de Chazelles*, a Member of the *Royal Academy of Sciences*, and Engineer of the King's Gallies, had Orders to make his

Observations, and send 'em to Court : A Copy of which he gave me, sign'd with his own Hand, and is as follows.

The Report of Monsieur de Chazelles.

An Experiment of the Swiftnefs of a Gally, with perpendicular revolving Oars, invented by Monsieur Du Quet ; compar'd with that of a common Gally. Made at Marfeilles, &c.

At 10 h. 3 min. in the Morning, the *Superbe* Gally quitted her Station over-against the *Augustins*, in order to fall down to the *Chain*.

At 10 h. 11 m. she came to the *Chain*.

At 10 h. 6 m. the *Machine* Gally quitted her Station, at the innermost Part of the Port. She had three *Machines* on each side.

10. 13. She came to the *Chain*.

10. 19. The two Gallies abreast. Both row with their whole Crews.

10. 25. The *Superbe* passes ; and then rows only with the hinder part of her Crew.

10. 27. The *Machine* Gally passes.

10. 28. Both row with their whole Crews.

10. 30. The *Superbe* Gally passes ; and then rows only with the fore part of her Crew.

10. 32. The *Machine* Gally passes ; upon which the *Superbe* Gally claps on more Oars, till such Time as she has acquir'd the same Velocity with the *Machine* Gally : And it appear'd, that with seven or eight Oars less than her Complement

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on each side, she kept up with the *Machine Gally* ; making about 200 Rowers, which was the Number of the *Machine Gally's* Crew. There was a little Wind a-head, which retarded the *Superbe* something more than it did the *Machine Gally* ; because the *Superbe* had her Masts and Yard-Arms standing, and the other not.

10. 43. Came to the Moorings of the *Isles*. The Sign given for turning.

10. 47. The *Superbe* was come about. It appear'd, that the *Machine Gally* was considerably quicker in turning than the *Superbe*.

10. 30. They came again into Port.

By this it appears, that the *Machine Gally* has a considerable Advantage over the common one, in quitting her Station, and acquiring her first Motion : For, in seven Minutes, she ran the whole Length of the Port ; having quitted her Station by means of her Oars, without towing her self by her Moorings ; which is what another Gally would not have effected, but very slowly. And the *Superbe* Gally, after she had mov'd from her Station, was eight Minutes in going a less Distance than the Length of the Port.

But if we consider the Experiment made without the Harbour, it seems to prove the common Gally to have the Advantage over the *Machine Gally*, tho' the Number of Hands be equal. For, with eight Oars less than her Complement on each side, she kept up with the *Machine Gally*, notwithstanding the greater Resistance of the Wind against her Masts. However, if we consider, that the Crew of the *Superbe* was a great deal better than that of the *Machine Gally* ;

that the *Superbe* is acknowledg'd to be one of the best Sailors the King has ; whereas that which had the *Machines*, is an old decay'd Gally, and reckon'd a very bad Sailor ; besides that the Crew of the *Superbe* are much better acquainted with the common Oar, than the others are with the new way of rowing ; and that in the common Gally there's no Improvement to be made, either with respect to the Proportion of the Oars, their Length, the Breadth of the Pallets, the Height of the Point of Rest, &c. or with respect to the Construction of the Vessel ; whereas in the *Machine*, there are several Things to be improv'd and alter'd in the Oars, the Hand-spikes, and in disposing the Men to the best Advantage. These Things, I say, consider'd, it seems reasonable to believe, that a Vessel with the *Machines* might go faster than one with the common Oars ; because the Loss of Time is avoided, which happens in the ordinary way of rowing.

This Experiment, however defective it be, for the Reasons above, will prove, That the Velocity is greater in this way of rowing than in the other, when the Circumstances on both sides are equal. For, by my Journal, I find, that the *Patronne*, in Company with fourteen other Gallies, left the Port of *Marseilles* at 50 min. past three ; and rowing all in a Calm, came to the *Isles* at 4 h. 23 min. ; which made 33 m. in going from the *Chain* to the *Isles*. But the *Machine* Gally made the same way, with 200 Men, in 30 min. having left the *Chain* at 10 h. 13 m. and arriv'd at the *Isles* at 10 h. 43 min. altho' there was some Wind a-head.

Sign'd CHAZELLES.

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This Experiment shews, that the *Impetus* does not depend upon the Number of Oars, but the Number of Men.

A Vessel charg'd with revolving Oars, will go as fast in a Calm with 100 Men, as it would do if towed by a Gally of 200 Men ; because there will be one Gally less to draw along.

Another Memoire of Monsieur Chazelles, concerning the Usefulness of perpendicular revolving Oars, invented by Monsieur Du Quet.

The Experiment made of the New *Machine*, altho' defective by reason of the Difference there was with respect both to the Crew and the Vessels, does yet leave room to expect a considerable Advantage from this Invention, in giving the Ship way : For tho' the common Gally should keep up with the *Machine* Gally at their first setting out, with equal Number of Hands ; 'tis evident, the *Machine* Gally will get the better at long Run, when the others Crew are so fatigu'd, as to be oblig'd to row by turns. For here the Men will hold out a longer Time, their Action not being so great, nor so violent. Besides, having only 200 Men employ'd, and being equally mann'd with the other Gally, fresh Hands may be supply'd, and so they will continue to go at the same Rate : For in case of need, the Marines may be employ'd in this Service ; which they will perform with as little Reluctance, or Trouble, as they work at the Capstane.

The Reason of this Increase of Velocity appears plain, if we consider the Difference between the com-
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mon way of rowing, and that by perpendicular Oars : The last is done by an uninterrupted Application of Force, in the same Direction ; the other acts by Jerks. And, of the three Parts of Action that are employ'd, in order to give the Strokes ; one in raising the Oar out of the Water, the second in advancing the Hands forwards, and the third in pressing against the Water ; only the last turns to Account : And that still loses something of its Efficacy ; for the Crew, by their falling back all together, make the Vessel plunge, and render its Motion oblique, which contributes very much to its Decay.

These are not the only Defects of the common Oars ; for, in order to augment their Force, the Number is to be increas'd, and consequently, the Vessel must have a greater Length ; by which means, it is render'd weaker and less able to resist the force of the Sea. Besides, the Vessel must be low-built, and uncover'd, (and so more expos'd to the beating in of the Waves) by reason they are obliged to proportion the Length of the Oar to the Strength and Size of the Men. And tho' the Crew should be under some Covert, as they are in a Galeass ; an Opening must be left for the Oars to play, by which the Waves may beat in.

Both these Inconveniencies are avoided, by the perpendicular Oars ; because the Addition of Force may be obtain'd, by only applying more Hands to the *Machine* ; so that with two or three *Machines* on a side, there will be more or less Force, in proportion to the Number of Men employ'd, and the Length of the Vessel may be lessen'd at Discretion. And to guard against the Sea, another Deck may be made, shut
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close on all sides, even where the *Axis* of the *Machine* passes through.

The chief Objections against this Invention, seem to me sufficiently obviated by Mr. *Du Quet's Memoir* : But tho' the whole of what is objected should indeed prove, That a Vessel made for sailing, as the common Gally, would be so incumber'd with the *Machines*, as to make the Use of Sails impracticable ; yet if it still holds true, that she will move faster ; as appears, both by Reason and Fact ; it must be allowed, that a Vessel might be so commodiously constructed, to carry these *Machines*, as to go as fast as a Gally in a Calm, and better endure the Weather when under Sail.

Such a Vessel would have several Advantages above a Gally, both in Sailing, and in Fight ; not to mention the Conveniencies of lodging the Crew. She may put off to Sea any where, and thereby avoid the Dangers attending the Coast-Winds, which Gallies find to be a-head as soon as they have doubled certain Capes ; and so they find themselves between two Winds, which there would be no Danger of, farther out at Sea. With respect to Fight, she may mount Cannon fore and aft, and on each side ; and even Mortar-pieces. In Time of Battel, she would be of wonderful Use ; for she would take and maintain her Post without Assistance, either at the Head, or the Rear of the Enemy's Line, and there make use of her Bombs : Besides the Advantages of towing off other Vessels from their Danger in a Calm, and of boarding, or making off from the Enemy. And this holds in Ships of any Rate ; provided the Length of the Oars, the
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Breadth of the Pallets, and the Strength of the Hand-spikes be proportionable. And the moving Force will always be in proportion to the Strength and Number of the Men employ'd, and not to the Number of *Machines*, as in the common Oars, which too are impracticable in Ships above the fourth Rate, by Reason of their great Length, which will be disproportionate to the ordinary Bulk of a Man.

By this means the Crew will be free from the Fatigue of towing, and the Vessel will move incomparably faster than if it was towed ; because the Chaloups which tow, are subject to the Inconveniencies of the common Way of towing, by losing two thirds of the Time ; and besides, they can't act all together : And the Vessel that is towed, pulling them back after the Oar has made its Stroke, they have so much of the Space to regain by the next Stroke. Besides, the Cable by which they tow, sinking into the Water by its own Gravity, the Resistance the Water makes to its Return, is to be overbalanced ; all which Circumstances together considerably diminish the towing Force.

Besides, this Invention is not such as is destructive to Mankind, and becomes useles to the Nation that first puts it in Practice, when generally known ; on the contrary, it may be greatly advantagious to the Inventors at the Beginning, and every where serviceable on many Occasions, when it is put in Practice by those who use the Sea.

Signed *CHAZELLES*.

Mr. *de Chazelles* might have added, that the Chaloups that tow, are in close Fight liable to be sunk by
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the Enemy's Cannon, and are exposed to the Waves by their having so little Height above Water.

It may be proper to explain the Advantages there are in boarding, or getting clear of the Enemy, by means of the new Oars.

The chief Advantage, and which includes all the rest, is, that let a Vessel crowd as much Sail as possible, the perpendicular Oars are always capable of increasing her Swiftneſs, becauſe the Rowers have only a Motion of three Foot to make one Way, and as much the contrary Way, in order to make the Oars deſcribe four and fifty Foot Space in the Water, and that Motion of ſix Foot might be perform'd in two Seconds of Time, if the Oars met with no Reſiſtance ; conſequently the Veſſel muſt run four and fifty foot in two Seconds, that is, about ſix Leagues an Hour, before thoſe revolving Oars be unſerviceable, for then the Veſſel would go as faſt as the Oars could poſſibly move with a Diameter of eighteen Foot ; and if it was neceſſary to make them move faſter, it is only lengthning out their Diameter, and they would move ſo much the faſter, without obliging the Rowers to increaſe their own Motion:

Mr. *Arnoult* was order'd to examine the new Oars ; and he made his Report to the Court, that the Officers of the Gallies found, that they interfered with the Uſe of the Sails in a Gally, but might be of Uſe in other Veſſels and Bomb-ketches ; in Conſequence of which, I was ſent to *Toulon* to make the Experiment on Board a Bomb-ketch.

At the Time when the Experiment was made, Mr. *de Vauvre*, and the Officers of the *Marine* were at Sea, and only ſome Officers of the *Port* were preſent,

sent, who sent a Verbal Process to the Court, without acquainting me with it, or offering any Objection, although I had very much press'd them to it, in order to obviate the Prejudices might be conceiv'd against this Novelty.

At my Return to *Paris*, Mr. *de Salabery*, surpriz'd at my knowing nothing of that Account, gave it me to answer, which I did Parâgraph by Parâgraph : The whole was given to a general Officer then at Court to examine, and make a Report of it, the Result of which was, That this Invention ought to be put in Practice.

XII. *Part of a Letter from the Reverend Mr. Rowlands, to the Reverend Mr. Derham, Prebendary of Windsor, and F. R. S. Concerning the stocking of the River Mene with Oysters.*

THE River of *Mene*, that divides *Anglesey* from *Carnarvonshire*, near which I live, has at present the Bottom of its Channel for some Miles in length, all bedded with good Oysters, in such Plenty, that in the Season, several Boats are daily employ'd to dredge them up, and have done so these eight or nine Years last past to their great Profit ; but what I recommend as observable, is, that about twenty four Years ago, we have good Assurance, that there were none to be found on that Bottom : but that a Gentleman about that Time, caus'd three or four hundred large